



Designing Single-Photon Sources: Towards Unity

Gregersen, Niels; Denning, Emil Vosmar; Mørk, Jesper

Publication date:
2018

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Gregersen, N., Denning, E. V., & Mørk, J. (2018). *Designing Single-Photon Sources: Towards Unity*. Abstract from 6th workshop on Engineering of Quantum Emitter Properties, Rome, Italy.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Designing Single-Photon Sources: Towards Unity

N. Gregersen^{1*}, E. V. Denning¹ and J. Mørk¹

*1. DTU Fotonik, Department of Photonics Engineering
Technical University of Denmark, Kongens Lyngby, DK-2800, Denmark*

* Electronic address: ngre@fotonik.dtu.dk

A key building block within optical quantum information technology is the single-photon source. The key figures of merit are the efficiency, defined as the number of photons detected by the collection optics per trigger, as well as the indistinguishability describing the coherence properties of the emitted photons. Spontaneous parametric down-conversion (SPDC) has been the main workhorse for generating single photons within quantum optics for many years; however SPDC is inherently probabilistic limiting the number of photons involved in an experiment to a handful.

Recently, the semiconductor quantum dot (QD) has emerged as an alternative to SPDC. By integrating the QD into a microstructure, the light emission can be controlled and extraction efficiency of around 0.7 [1,2] have been achieved. Furthermore, using resonant excitation and careful control of the neighbouring charge environment, indistinguishability up to 0.99 [2,3] has been demonstrated. However, future progress within QD-based single-photon sources will require the combination of high efficiency with high indistinguishability.

In this presentation, I will discuss the physical limitations of present-day design schemes, which must be overcome to combine near-unity efficiency and indistinguishability. I will discuss new promising QD-based design schemes and I will discuss the challenges ahead.

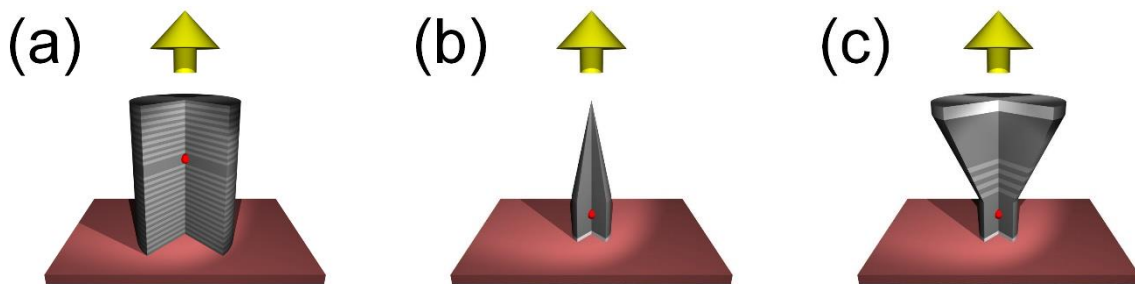


Figure 1: Major single-photon source design strategies: (a) The micropillar cavity, (b) the photonic nanowire and (c) the photonic “trumpet” geometry.

- [1] J. Claudon et al., *Nat. Photonics* **4**, 174–177 (2010). M. Munsch et al., *Phys. Rev. Lett.* **110**, 177402 (2013). O. Gazzano et al., *Nat. Commun.* **4**, 1425 (2013).
- [2] X. Ding et al., *Phys. Rev. Lett.* **116**, 020401 (2016).
- [3] N. Somaschi et al., *Nat. Photonics* **10**, 340–345 (2016)